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# BIRD AND RODENT ABUNDANCE AT YARD-WASTE COMPOST FACILITIES IN NORTHERN OHIO

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Bird strikes to aircraft are of increasing concern to the Federal Aviation Administration (FAA), the armed forces, and the air transport industry (Solman 1984, Dolbeer et al. 1989, Bivings and Medve 1990, Vuillermet and Briot 1990). Traditional putrescible-waste landfills often attract birds, especially gulls, for feeding (Burger and Gochfeld 1983, Patton 1988). FAA Order 5200.5, issued in 1974, recommends that putrescible-waste landfills and other waste-management facilities be located >1.5 km from runways used by piston-powered aircraft and >3 km from runways used by turbine-powered aircraft. This order was revised in 1990 (Order 5200.5A) to recommend against locating waste-management facilities within 3–8 km of a runway if such facilities "attract or sustain hazardous bird movements from feeding, water or roosting areas into, or across the runways and/or approach and departure patterns of aircraft."

To extend the life of traditional landfills, regulations are being adopted in many localities to require that yard waste (lawn clippings, leaves, wood chips) be deposited in separate facilities for composting and recycling as mulch. As no data are available on bird use of compost facilities, the FAA presently includes these facilities under Order 5200.5A. In addition to aircraft safety concerns by the FAA, the general public has concerns about compost facilities as potential attractants to nuisance wildlife. Objective data are needed on wildlife use of such facilities for wildlife biologists to advise regulatory agencies and local governments regarding the siting of compost facilities.

Our initial objective was to determine if compost sites attracted birds by comparing bird species and abundance at 2 yard-waste compost sites with 2 similar nearby comparison sites (i.e., undeveloped open land typical of sites surrounding airports) in northern Ohio. During our observations, we noted Norway rat (*Rattus norvegicus*) burrows in leaf compost at 1 site. As rodents are prey to many bird species (Baker and Brooks 1981, Johnsgaard 1990) and often of concern to the public in urban areas, our second objective was to com-

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pare rodent species and abundance at the 2 pairs of sites.

## STUDY AREAS

### *Cuyahoga County*

The compost site, in operation since 1988, was located near East 55th Street in Cleveland, Ohio about 0.8 km south of Lake Erie. Leaves and wood chips were piled in windrows 15–60 m long and 2–4 m high. The perimeter of the 2-ha facility contained grasses, scattered trees, and shrubs; the remainder was paved or bare ground. The 2-ha comparison site, the abandoned Marquette Electric Substation, was located 1.0 km west of the compost site. This area was primarily grasses and forbs, with shrubs and several trees along the border. Both facilities were fenced and located in an urban industrial area surrounded by highways, railroad tracks, and vacant lots.

### *Erie County*

The compost site, opened in May 1991, was located 1 km south of Lake Erie, 3 km west of Huron, Ohio and 100 km west of the Cuyahoga County compost site. The 2-ha facility was in a rural area surrounded by farmland, a tree nursery, and a highway. The comparison site was a 2-ha field 3 km southwest of the compost site. The field consisted of mowed lawn (0.5 ha) and old-field habitat (1.5 ha) surrounded by open fields, trees, and a parking lot.

## METHODS

### *Birds*

*Cuyahoga County.*—Bird observations were made at each site once weekly from 20 June 1991–27 May 1992. An observer recorded bird numbers for the entire site for either 12 (compost) or 6–12 (comparison) consecutive 5-minute intervals. The observer identified species and placed birds into 1 of 4 categories (flying over but not landing at site; on ground at site but not on compost; on compost; feeding on compost) during each 5-minute interval. We included birds "flying over but not landing" in our analyses because FAA officials expressed concern that certain bird species might be attracted to compost areas to soar on thermals or to investigate trucks unloading material. Also, this category quantified the number of birds in the surrounding area that could have landed within the facility but did not. Observations were made between 0800–1700 hours and alternated weekly between randomly selected times before and after 1200 hours. The site (compost or comparison) observed first each week was alternated and the same observer made observations at each site during the weekly visit. An assistant was present to record and assist with observations.

To monitor gull numbers in the general area, we also counted the number of gulls by species at the Cleveland Lakefront Park and Marina (CLPM) 0.8 km north of the compost site. All gulls at the park-marina complex and on breakwalls were included in the count, which we conducted between or immediately following observations at the compost and comparison sites.

*Erie County.*—We observed each site for 5 minutes 1–2 times daily 5 days/week from 1 July 1991–31 July 1992. Observations were at a randomly chosen morning and afternoon time between 0800–1630 hours. Methods were similar to those used at Cuyahoga County sites.

We used $t$-tests to compare mean number of species/month for each pair of sites. Because any 5-minute period was not independent of the next or previous 5-minute period, we calculated the daily mean number of birds/5 minutes for each site and used 1-way analysis of variance (ANOVA) (SAS Inst., Inc. 1988) to determine differences in daily means between each compost site and its comparison site.

### *Rodents*

We trapped at the Cuyahoga County compost site from 9–13 August 1991 and the comparison site from 9–12 August 1991. Both Cuyahoga County sites were trapped from 31 December 1991–3 January 1992. The Erie County sites were trapped from 30 January–2 February 1992 and 12–15 August 1992. We visually estimated the proportion of habitats within each study area (e.g., wood compost, leaf compost, field, lawn) and established trap stations in proportion to available habitat within each site. Traps were baited with a mixture of peanut butter, oats, and dog food, checked daily, and reset with new bait after recording the species caught or trap status (sprung or unsprung).

Three types of snap traps (Woodstream Corp., Lititz, Pa.) were used at the Cuyahoga County sites in August only: Victor® rat traps, Museum Special traps, and Victor® mouse traps. One trap of each type was placed within a 4-$m^2$ area at each of 25 locations at each site. Traps were often moved each day to different locations within the 4-$m^2$ area. On the night of 13 August at the Cuyahoga County compost site, Museum and mouse traps were removed and the 25 rat traps from the comparison site were set at new locations at the compost site in addition to the 25 rat traps already present.

During the remaining three trapping periods, we established 30 trapping stations at each site using only rat and mouse traps placed approximately 1 m apart. Trap stations within a habitat were spaced 10 m apart and were moved about 5 m each day, generally within the same habitat.

We defined capture rate as the number of animals captured/100 adjusted trap nights (ATN, King 1989). Traps that were sprung, missing, or held an animal were counted as 0.5 trap night; unsprung traps were counted as 1 trap night. Because of their small size, Museum and mouse traps were not considered adequate to capture Norway rats. We used chi-squared

statistics for proportional data (Fleiss 1973) to compare rates of capture by species and between pairs of study areas.

Procedures used in this study were approved by the Animal Care and Use Committee of the Denver Wildlife Research Center.

## RESULTS

### *Birds*

*Cuyahoga County.*—We recorded 52 and 38 species of birds at the compost and comparison sites, respectively, with 55 different species at both sites combined. A higher ($P < 0.01$) mean number of species/month was recorded at the compost site than the comparison site (Table 1). Mean number of total birds/5 minutes was highest at the compost site in January and at the comparison site from March–May (Fig. 1). Mean number of birds flying over/5 minutes did not differ ($P = 0.60$, Table 1) between the 2 sites, but mean number of birds on ground at site/5 minutes was higher ($P < 0.04$) at the comparison site. Forty-eight percent of birds on the ground at the compost site were on the compost piles; 8% of those on the ground within the site were observed feeding on the compost piles. Total birds/5 minutes (flying over plus on ground) was not different ($P = 0.39$) between the 2 sites (Table 1).

At the compost site, ring-billed gulls (*Larus delawarensis*) and European starlings (*Sturnus vulgaris*) were the most numerous species (Table 2; species for which <150 individuals were observed are listed in Gabrey et al. 1992). All gulls observed (6,692 ring-billed, 145 herring [*L. argentatus*], 19 Bonaparte's [*L. philadelphia*], and 10 unidentified) were recorded

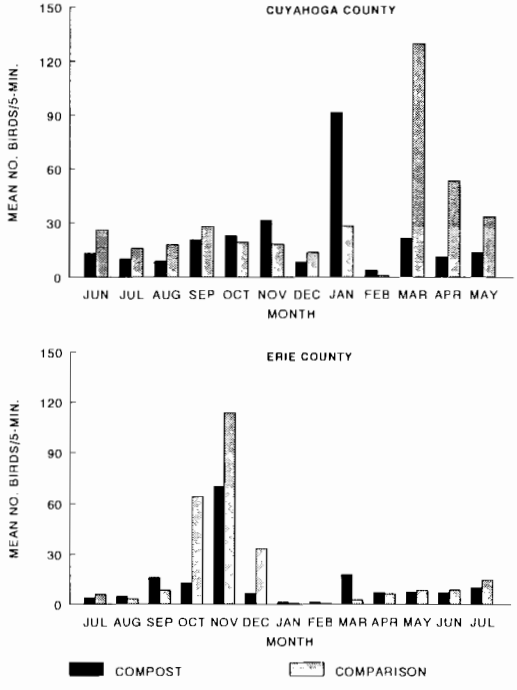


Fig. 1. Monthly mean number of birds/5 minutes recorded flying over or on ground at 2 yard-waste compost sites and 2 nearby comparison sites, northern Ohio, June 1991–July 1992.

Table 1. Mean number of bird species/month and mean number of birds/5-minutes at the Cuyahoga County compost ($n = 625$ 5-min observation periods) and comparison ($n = 456$) sites and Erie County compost ($n = 516$) and comparison ($n = 472$) sites, June 1991–July 1992.

| | Bird species recorded/month | | Birds flying over/ 5-minutes | | Birds on ground/ 5-minutes | | Total birds/ 5-minutes | |
|---|---|---|---|---|---|---|---|---|
| County | Compost | Comparison | Compost | Comparison | Compost | Comparison | Compost | Comparison |
| Cuyahoga | 17.8[a] | 14.7[a] | 20.3[b] | 15.4[b] | 2.1[c] | 16.9[c] | 22.4[d] | 32.3[d] |
| Erie | 15.9[e] | 15.2[e] | 11.7[f] | 16.1[f] | 1.5[g] | 4.3[g] | 13.2[h] | 20.4[h] |

[a] Means are different ($t = 3.23$, 11 df, $P < 0.01$, paired-difference $t$-test on means of monthly totals).
[b] Means are not different ($F = 0.27$, 1, 100 df; $P = 0.60$, 1-way ANOVA on daily means).
[c] Means are different ($F = 4.49$; 1, 100 df; $P < 0.04$, 1-way ANOVA on daily means).
[d] Means are not different ($F = 0.73$; 1, 100 df; $P = 0.39$, 1-way ANOVA on daily means).
[e] Means are not different ($t = 0.55$, 12 df, $P = 0.59$, paired-difference $t$-test on means of monthly totals).
[f] Means are not different ($F = 0.38$; 1, 483 df; $P = 0.54$, 1-way ANOVA on daily means).
[g] Means are different ($F = 5.09$; 1, 483 df; $P = 0.02$, 1-way ANOVA on daily means).
[h] Means are not different ($F = 0.84$; 1, 483 df; $P = 0.36$, 1-way ANOVA on daily means).

Table 2. Bird species recorded during 5-minute observation periods at Cuyahoga County compost ($n$ = 625) and comparison ($n$ = 456) sites and Erie County compost ($n$ = 516) and comparison ($n$ = 472) sites, northern Ohio, June 1991–July 1992.

| Location<br>Species | Percent of observation periods recorded | Total number observed | Percent of population | |
|---|---|---|---|---|
| | | | Flying over | On ground |
| Cuyahoga County compost | | | | |
| Ring-billed gull (*Larus delawarensis*) | 29 | 6,692 | 100 | 0 |
| European starling (*Sturnus vulgaris*) | 49 | 3,375 | 98 | 2 |
| Mourning dove (*Zenaida macroura*) | 31 | 1,036 | 46 | 54 |
| Chimney swift (*Chaetura pelagica*) | 11 | 505 | 100 | 0 |
| Rock dove (*Columba livia*) | 20 | 440 | 49 | 51 |
| Red-winged blackbird (*Agelaius phoeniceus*) | 14 | 250 | 88 | 12 |
| Killdeer (*Charadrius vociferus*) | 12 | 223 | 18 | 82 |
| House sparrow (*Passer domesticus*) | 9 | 164 | 98 | 2 |
| Other (44 species) | | 1,338 | 72 | 28 |
| Total | | 14,023 | 90 | 10 |
| Cuyahoga County comparison | | | | |
| European starling (*Sturnus vulgaris*) | 53 | 11,756 | 27 | 73 |
| Ring-billed gull (*Larus delawarensis*) | 20 | 2,280 | 100 | 0 |
| Rock dove (*Columba livia*) | 25 | 591 | 52 | 48 |
| Red-winged blackbird (*Agelaius phoeniceus*) | 16 | 382 | 22 | 78 |
| Chimney swift (*Chaetura pelagica*) | 13 | 360 | 100 | 0 |
| Mourning dove (*Zenaida macroura*) | 18 | 225 | 57 | 43 |
| American robin (*Turdus migratorius*) | 18 | 173 | 48 | 52 |
| Other (31 species) | | 742 | 68 | 32 |
| Total | | 16,509 | 43 | 57 |
| Erie County compost | | | | |
| European starling (*Sturnus vulgaris*) | 53 | 4,119 | 90 | 10 |
| Red-winged blackbird (*Agelaius phoeniceus*) | 6 | 539 | 99 | 1 |
| Common grackle (*Quiscalus quiscula*) | 11 | 262 | 99 | 1 |
| Ring-billed gull (*Larus delawarensis*) | 8 | 254 | 100 | 0 |
| Mourning dove (*Zenaida macroura*) | 19 | 185 | 91 | 9 |
| Killdeer (*Charadrius vociferus*) | 16 | 158 | 47 | 53 |
| Other (36 species) | | 1,050 | 86 | 14 |
| Total | | 6,567 | 88 | 12 |
| Erie County comparison | | | | |
| European starling (*Sturnus vulgaris*) | 28 | 7,367 | 86 | 14 |
| American robin (*Turdus migratorius*) | 34 | 647 | 14 | 86 |
| Tree swallow (*Tachycineta bicolor*) | 7 | 265 | 99 | 1 |
| Ring-billed gull (*Larus delawarensis*) | 3 | 256 | 100 | 0 |
| Brown-headed cowbird (*Molothrus ater*) | 4 | 179 | 81 | 19 |
| Killdeer (*Charadrius vociferus*) | 15 | 150 | 15 | 85 |
| Other (42 species) | | 904 | 60 | 40 |
| Total | | 9,768 | 79 | 21 |

as flying over. At the comparison site, starlings were most numerous, followed by ring-billed gulls (Table 2). All gulls observed (2,280 ring-billed, 112 herring, 51 Bonaparte's, and 4 unidentified) were recorded as flying over. Of all birds at the compost and comparison sites, 90% and 43% (Table 2) were observed flying over, respectively.

Gulls were often abundant in areas surrounding the compost and comparison sites, especially during November–January. For example, at nearby CLPM, ≥10 gulls were ob-

Table 3. Number of raptors/5-minutes flying over or on the ground at 2 yard-waste compost sites and 2 nearby comparison sites, northern Ohio, June 1991–July 1992.

| Species | Location | | | |
|---|---|---|---|---|
| | Cuyahoga County | | Erie County | |
| | Compost ($n$ = 625) | Comparison ($n$ = 456) | Compost ($n$ = 516) | Comparison ($n$ = 472) |
| American kestrel (*Falco sparverius*) | 0.04 | 0.14 | <0.01 | 0.04 |
| Red-tailed hawk (*Buteo jamaicensis*) | <0.01 | 0.01 | <0.01 | 0.03 |
| Cooper's hawk (*Accipiter cooperii*) | <0.01 | 0.01 | 0 | 0 |
| Turkey vulture (*Cathartes aura*) | 0 | 0 | 0.01 | 0.04 |
| Sharp-shinned hawk (*Accipiter striatus*) | <0.01 | 0 | <0.01 | <0.01 |
| Northern harrier (*Circus cyaneus*) | 0 | 0 | 0 | <0.01 |
| Osprey (*Pandion haliaetus*) | 0 | 0 | <0.01 | 0 |
| All raptors | 0.05 | 0.15 | 0.03 | 0.11 |

served on 40 of 52 observation days, and ≥500 gulls were present on 10 days. A mean of 2,166 gulls/observation was recorded from November–January.

Four raptor species were recorded at the compost site and 3 at the comparison site during the study (Table 3). Seven of 26 American kestrels observed at the compost site were on the ground; 20 of 64 kestrels, 1 red-tailed hawk, and 1 Cooper's hawk were recorded on the ground at the comparison site. Birds of prey were 3 times more abundant at the comparison than at the compost site.

*Erie County.*—We recorded 43 and 48 species of birds at the compost and comparison sites, respectively, with 56 different species at both sites combined. Mean number of birds/5 minutes (flying over plus on ground) was similar at both sites ($P = 0.36$), although more ($P = 0.02$) birds/5 minutes were on the ground at the comparison site than at the compost site (Table 1). Mean number of birds/5 minutes was highest during November at both sites (Fig. 1). Of the birds on the ground within the compost site, 31% were on the compost piles. Seven percent of the birds within the compost site were observed feeding on compost piles.

Starlings were the most numerous species at both sites. Ninety percent of the starlings at the compost and 86% at the comparison site (Table 2) were observed flying over. Of all birds recorded at the compost site, 88% were flying over compared to 79% at the comparison site (Table 2).

All gulls observed at the compost site (254 ring-billed, 43 herring, and 25 unidentified) were recorded as flying over. All gulls observed at the comparison site (256 ring-billed, 19 herring, and 2 unidentified) were recorded as flying over.

At each site, we observed 5 species of birds of prey, including turkey vultures (Table 3). One of 2 kestrels observed at the compost site was on the ground. No raptors were on the ground at the comparison site. Raptors were recorded 4 times more often at the comparison than at the compost site.

### *Rodents*

*Cuyahoga County.*—During August, number of rodents captured did not differ ($\chi^2 = 0.01$, 1 df, $P > 0.10$) between the 2 sites. However, species composition was different (Table 4). Norway rats comprised 95% (20.2/100 ATN) of the catch at the compost site compared with only 14% (3.5/100 ATN) at the comparison site. White-footed mice (*Peromyscus leucopus*) and meadow voles (*Microtus pennsylvanicus*) comprised the remainder at the comparison site (77% and 9%, respectively). The number of Norway rats captured at the com-

Table 4. Number of rodents in snap traps at 2 yard-waste compost sites and 2 nearby comparison sites, northern Ohio, August 1991–August 1992.

| County | Site | Dates | Capture rates by species (individuals/100 adjusted trap nights) | | | | |
|---|---|---|---|---|---|---|---|
| | | | *Rattus norvegicus* | *Peromyscus leucopus* | *Microtus pennsylvanicus* | *Mus musculus* | *Zapus hudsonius* |
| Cuyahoga | Comparison | 9–12 Aug | 3.5 | 7.2 | 0.8 | 0.0 | 0.0 |
| | Compost | 9–13 Aug | 20.2 | 0.3 | 0.0 | 0.0 | 0.0 |
| | Comparison | 31 Dec–3 Jan | 0.0 | 3.2 | 0.0 | 0.0 | 0.0 |
| | Compost | 31 Dec–3 Jan | 4.5 | 1.3 | 0.0 | 0.4 | 0.0 |
| Erie | Comparison | 12–15 Aug | 0.0 | 2.9 | 1.0 | 0.0 | 1.9 |
| | Compost | 12–15 Aug | 0.0 | 1.9 | 0.0 | 0.5 | 0.0 |
| | Comparison | 30 Jan–2 Feb | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 |
| | Compost | 30 Jan–2 Feb | 0.0 | 4.5 | 0.0 | 0.4 | 0.0 |

post site declined from 47 rats/100 ATN on 9 August to 6 rats/100 ATN on 13 August. Most rats at the compost site were trapped on or adjacent to compost piles. Rat burrows were frequently observed in leaf and wood-chip compost.

During December–January, number of rodents captured did not differ ($\chi^2 = 0.2$, 1 df, $P > 0.05$) between the 2 sites (Table 4). However, species composition differed. Norway rats were captured only at the compost site, and only white-footed mice were captured at the comparison site. Except for 2 rats, all rodents captured at the compost site during winter occurred near a pile of rocks and concrete. Winter capture rate was less ($\chi^2 = 18.77$, 1 df, $P < 0.01$) than summer.

*Erie County.*—During August, there was no difference ($\chi^2 = 2.55$, 1 df, $P > 0.10$) in the number of rodents captured at the comparison and compost site. White-footed mice were the most prevalent rodent captured at both sites (Table 4). Meadow jumping mice (*Zapus hudsonius*) comprised 33% of the catch at the comparison site.

During January–February, only 1 rodent was captured at the comparison site (Table 4). Eight of 10 white-footed mice captured at the compost facility were removed from a pile of conifer trees that had not been chipped.

## DISCUSSION

Gulls often are a serious hazard at airports located near water or putrescible-waste landfills (Lake 1984, Patton 1988). However, gulls were not attracted to either yard-waste compost facility, as no gulls were recorded on the ground. Peak numbers of gulls flying over the Cuyahoga County compost and comparison sites coincided with the peak numbers at CLPM, November–January (Gabrey et al. 1992). Thus, the large number of gulls recorded flying over the Cuyahoga County compost and comparison sites in winter probably was related to the sites' proximity to Lake Erie and unrelated to any site characteristics. The number of gulls recorded flying over the Erie County sites was surprisingly low given the 4,000-nest herring gull colony <7 km away on Lake Erie (Dolbeer et al. 1990) and the several thousand gulls often recorded at the Erie County Landfill 5 km south of the sites (Belant et al. 1993).

Although the total birds/5 minutes (flying over plus on the ground) was similar between each compost and comparison site, the number of birds on the ground at the compost sites was much lower than at the comparison sites. Fewer than 10% of the birds on the ground at the compost sites were observed feeding on insects,

acorns, or other material in the compost, even when compost piles were being turned. Overall, 88–90% of the birds observed at the compost sites were apparently uninfluenced by the presence of the compost.

A higher mean number of species/month was recorded at the Cuyahoga County compost site than at the comparison site. This difference may be because we observed for a longer period of time at the compost site (1 hour/week) than at the comparison site (0.5 hour) during the first 6 months of the study.

Rodents were present at all 4 sites with approximately equal numbers detected at the paired compost and comparison sites. Therefore, compost facilities should not attract birds of prey in greater numbers than nearby vacant lots or fields. In fact, birds of prey (including vultures) were recorded less often at the compost sites (0.5 individual/hour) than at the comparison sites (1.5 individuals/hour).

The Norway rat population was greater at the Cuyahoga County compost facility than at the comparison site; Norway rats were absent from both Erie County sites. Thus, if Norway rats are already established in an area, compost facilities, which offer more burrow sites than vacant lots, may contain population levels greater than in surrounding areas. Therefore, we recommend monitoring urban compost facilities and implementing control programs (trapping or rodenticide baiting) when these rodents are present.

In conclusion, the 2 yard-waste compost sites did not attract birds or rodents above local background levels. Such facilities, if located near airports, should not affect aviation safety any more than vacant lots. However, compost facilities in urban areas may harbor concentrations of Norway rats requiring control programs.

## SUMMARY

We compared bird and rodent presence at 2 compost sites and 2 nearby comparison sites (vacant lots) in northern Ohio to determine if yard-waste compost facilities attract birds at higher than background levels, thus posing a threat to aircraft safety when situated near airports. We recorded 52 and 43 species of birds at the 2 compost sites from June 1991–July 1992, compared to 38 and 48 species at respective comparison sites. Overall, European starlings and ring-billed gulls were the most numerous species on the ground or flying over the sites. Total birds at the compost sites were similar to numbers at the respective comparison sites. At the compost sites, only 10–12% of the birds were observed on the ground; 7–8% of these were recorded feeding on the compost. Thus, most birds at the compost sites were not attracted to the compost. At the comparison sites, 21–57% of all birds were observed on the ground. No differences were detected between compost and comparison sites in the number of rodents captured, but species composition varied. Norway rats were present at urban study sites (Cuyahoga County) only. Birds of prey were observed about 3 times more often at the comparison sites.

Thus, yard-waste compost facilities studied in northern Ohio did not enhance bird or rodent numbers above local background levels. Similar facilities, if located near airports, would be unlikely to affect aircraft safety. Compost facilities in urban areas may harbor concentrations of Norway rats requiring control programs.

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